

CLAIMS

1. An embolic protection device comprising:

5 a collapsible filter element for delivery through a vascular system of a patient;

the filter element comprising a collapsible filter body and a filter support frame contacting the filter body;

10 the collapsible filter body having an inlet end and an outlet end, the inlet end of the filter body having one or more inlet openings sized to allow blood and embolic material enter the filter body, the outlet end of the filter body having a plurality of outlet openings sized to allow through passage of blood but to retain undesired embolic material within the filter body;

15 the filter support frame having a longitudinal axis and being movable between a collapsed position for movement through the vascular system and an extended outwardly projecting position to support the filter body in the expanded position;

20 the frame having a plurality of engagement segments, the engagement segments being spaced-apart longitudinally and transversely when the filter is in the deployed expanded configuration to urge the filter body into apposition with the vessel wall.

- 25 2. An embolic protection device as claimed in claim 1 wherein the engagement segments define at least one at least partially substantially helical engagement track.
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- 20 -

3. An embolic protection device as claimed in claim 1 or 2 wherein the frame comprises a number of frame elements, at least some of the frame elements having an engagement segment.
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4. An embolic protection device as claimed in claim 3 wherein at least some of the frame elements are interconnected.
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5. An embolic protection device as claimed in any preceding claim wherein the frame has an intermediate section and a proximal section extending from the intermediate section, the engagement segments being provided in the intermediate section of the frame.
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6. An embolic protection device as claimed in claim 5 wherein the proximal section of the frame extends radially inwardly of the intermediate section and defines at least one inlet hole to accommodate inflow of embolic material to be captured in the filter.
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7. An embolic protection device as claimed in claim 6 wherein the proximal section of the frame has a proximal mounting for mounting on a filter carrier.
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8. An embolic protection device as claimed in claim 7 wherein the proximal mounting is substantially tubular.
9. An embolic protection device as claimed in any of claims 5 to 8 wherein the proximal mounting is offset with respect to the longitudinal axis of the support frame.

- 21 -

10. An embolic protection device as claimed in any of claims 5 to 9 wherein the proximal section of the frame is flexible with respect to the intermediate section of the frame.
- 5 11. An embolic protection device as claimed in claim 10 wherein the proximal section of the frame comprises a number of proximal elements, at least some of which are of a flexible material.
- 10 12. An embolic protection device as claimed in claim 11 wherein the proximal section of the frame comprises a plurality of flexible elements of relatively low column strength which are movable individually and independently of the intermediate section between taut and slack configuration.
- 15 13. An embolic protection device as claimed in claim 11 or 12 wherein the frame includes a distal section extending from the intermediate section, the distal section of the frame being flexible with respect to the intermediate section of the frame.
- 20 14. An embolic protection device as claimed in claim 13 wherein the distal section of the frame includes a plurality of flexible elements of relatively low column strength which are movable individually and independently of the intermediate section between taut and slack configurations.
- 25 15. An embolic protection device as claimed in any of claims 12 to 14 wherein the flexible elements are thread-like elements.
- 30 16. An embolic protection device as claimed in any of claims 12 to 15 wherein at least some of the flexible elements define tethers.
17. An embolic protection device as claimed in any of claims 5 to 16 wherein the frame has a distal section extending from the intermediate section.

- 22 -

18. An embolic protection device as claimed in claim 17 wherein the distal section of the frame extends radially inwardly of the intermediate section.
- 5 19. An embolic protection device as claimed in claim 18 wherein the distal section of the frame has a distal mounting for mounting on a filter carrier.
20. An embolic protection device as claimed in claim 19 wherein the distal mounting is substantially tubular.
- 10 21. An embolic protection device as claimed in any of claims 17 to 20 wherein the distal mounting is offset with respect to the longitudinal axis of the support frame.
- 15 22. An embolic protection device as claimed in any of claims 17 to 21 wherein the distal section of the frame is flexible with respect to the intermediate section of the frame.
- 20 23. An embolic protection device as claimed in any of claims 5 to 21 wherein at least the intermediate section of the support frame is formed from wire.
24. An embolic protection device as claimed in any of claims 5 to 21 wherein at least the intermediate section of the support frame is formed by a slotted tube.
- 25 25. An embolic protection device as claimed in any of claims 5 to 23 wherein at least the intermediate section of the support frame is an elastic, superelastic and/or a shaped memory material.
- 30 26. An embolic protection system as claimed in any of claims 5 to 25 wherein at least the intermediate section of the support frame is of Nitinol.

- 23 -

27. An embolic protection device as claimed in any of claims 3 to 26 wherein the included angle defined between adjacent frame elements is less than 90°.
28. An embolic protection device as claimed in claim 27 wherein the included angle is less than 60°.
29. An embolic protection device as claimed in any of claims 3 to 28 wherein at least a portion of a support frame element is offset from the longitudinal axis by an angle of less than 45° in the expanded configuration.
30. An embolic device as claimed in any preceding claim wherein a support frame element is offset from the longitudinal axis by an angle of less than 10° when the frame is in the collapsed configuration.
31. An embolic protection device as claimed in claim 30 wherein a support frame element is offset from off the longitudinal axis by angles of less than 5° when the frame is in the collapsed configuration.
32. An embolic protection device as claimed in any preceding claim wherein the engagement segments are defined by segments of a single frame element.
33. An embolic protection device as claimed in claim 32 wherein the frame element is at least partially of helical shape.
34. An embolic protection device as claimed in any preceding claim wherein the collapsible filter body is mounted to the support frame.

- 24 -

35. An embolic protection device comprising:

a collapsible filter element for delivery through a vascular system of a patient;

the filter element comprising a collapsible filter body and a filter support frame contacting the filter body;

the collapsible filter body having an inlet end and an outlet end, the inlet end of the filter body having one or more inlet openings sized to allow blood and embolic material enter the filter body, the outlet end of the filter body having a plurality of outlet openings sized to allow through passage of blood but to retain undesired embolic material within the filter body;

the filter support frame having a longitudinal axis and being movable between a collapsed position for movement through the vascular system and an extended outwardly projecting position to support the filter body in the expanded position;

the frame having an intermediate section and a proximal section extending from the intermediate section; and

the proximal section of the frame being flexible with respect to the intermediate section of the frame.

36. An embolic protection device as claimed in claim 35 wherein the proximal section of the frame comprises a plurality of flexible elements of relatively low column strength which are movable individually and independently of the intermediate section between taut and slack configuration.

- 25 -

37. An embolic protection device as claimed in claim 35 or 36 wherein the frame includes a distal section extending from the intermediate section, the distal section of the frame being flexible with respect to the intermediate section of the frame.
38. An embolic protection device as claimed in claim 37 wherein the distal section of the frame includes a plurality of flexible elements of relatively low column strength which are movable individually and independently of the intermediate section between taut and slack configurations.
39. An embolic protection device as claimed in any of claims 36 to 38 wherein the flexible elements are thread-like elements.
40. An embolic protection device as claimed in any of claims 36 to 39 wherein at least some of the flexible elements define tethers.